CHAPTER 3

WATER QUALITY ASSESSMENT OF GROUNDWATER

WATER QUALITY ASSESSMENT OF GROUNDWATER

Introduction

An overall program of information dissemination, research in the three basic groundwater regions of Kentucky, and regulation of groundwater use constitute the major elements of Kentucky's groundwater protection program. In addition, collection of data for a groundwater data base has continued at a steady pace. Major studies in Kentucky groundwater are shown in Table 26. The studies are being performed throughout the state by various state and federal agencies and universities.

Two projects mentioned in the table deserve more attention because of their scope and similarity:

(1) In 1990, the University of Kentucky College of Agriculture was mandated by the General Assembly of the Commonwealth to assess the influence of agricultural practices upon groundwater. In cooperation with the Division of Water, ten areas have been selected for detailed studies. These areas include regions of intensive and diverse farming on all the types of bedrock/soil available in Kentucky (including karst drainage in the Bluegrass Region, karst drainage in the Western Pennyroyal Region, and unconsolidated sediments in the Jackson Purchase Region). Data for the first year have been analyzed and preliminary conclusions are being formulated. In 1991, the project was expanded from 2 to 5 farms. Also, experiments with various agricultural techniques, such as pesticide pollution in relation to type of tillage used, are being conducted.

(2) In 1990, the Nonpoint Source Section of the Division of Water awarded its first grant, under Section 319 of the Clean Water Act of 1987, to study nonpoint source pollution in Kentucky. Since that time, several agencies have received money through the Division for the study of nonpoint pollution as it pertains to groundwater (see Table 26 for those studies with 319 in parentheses). Each study monitors groundwater levels and collects samples for analysis of various pesticides and nitrates, and/or other constituents, that may have been introduced by current agricultural practices, or the study monitors the changes brought about by switching from current agricultural practices to best management practices (BMPs).

Most of the groundwater work in the state is being conducted by agencies receiving money from the University of Kentucky College of Agriculture or the Division of Water. The studies will contribute significant water quality data for several critical areas of Kentucky when completed.

Table 26
Major Studies in Groundwater

Agency	Hydrologic System	Description	Status
Division of Water (319)		Groundwater Exhibit to be displayed in the American Museum of Caves, Horse Cave, Kentucky	Starting
Division of Water (319)	Mammoth Cave	Monitor surface water in karst and cave area in relation to agricultural activities	In Progress
Division of Water (Groundwater Branch)	Aquifers	Conduct technical reviews of all geological and hydrologic plans and activities related to the Paducah Gaseous Diffusion Plant	In Progress
Division of Water (Groundwater Branch) (319)	Spring Systems	Monitor 3 spring systems for pesticides as a result of agricultural activity	In Progress
Kentucky Geological Survey	Aquifers	Study effects of abandoned mine lands on water quality	In Progress
Kentucky Geological Survey	Aquifers	Study effects of deep coal mines on hydrogeology, Eastern Kentucky Coal Field	Starting
Kentucky Geological Survey	Aquifers	Study groundwater geochemistry and its relationship to groundwater flow in Eastern Kentucky Coal Field	Starting
Kentucky Geological Survey (UK College of Agriculture)	Spring System	Study hydrogeology of Garretts' Spring (Sinking Creek) Drainage Basin	In Progress

Table 26 Continued

Agency	Hydrologic System	Description	Status
Kentucky Geological Survey (UK College of Agriculture)	Drainage Basin	Study hydrology of a drainage basin in relation to agricultural practices in Hickman County	In Progress
Kentucky Geological Survey	Kentucky River Basin	Reconnaissance of groundwater resources within the Kentucky River Basin	Completed
Kentucky Geological Survey		Kentucky Aquifer Research Database (KARD)	In Progress
Kentucky Geological Survey	Knox Group	Study production of fresh water from the Knox Group	In Progress
Kentucky Geological Survey (319)	Spring System	Monitor Pleasant Grove Spring drainage basin for nonpoint source pollution	In Progress
Kentucky Geological Survey		Study riparian vegetation effects on water quality using models and experiments	Starting
Kentucky Geological Survey	Surface mine spoil	STARFIRE: Monitor mine spoil to determine water quality	In Progress
Kentucky Geological Survey	Groundwater Basin	Monitor Robinson Forest groundwater basin before and during coal mining activities	Starting
Kentucky State University	Groundwater Basin	Describe and assess impacts and processes associated with agricultural practices	In Progress

Table 26 (Continued)

Agency	Hydrologic System	Description	Status
University of Kentucky (College of Agriculture)	Groundwater Basins	Study agricultural chemical use impacts on groundwater resources in selected sites in Kentucky	In Progress
University of Kentucky (Geological Sciences)	Groundwater Basin	Study effects of land-use on water quality at 4 watersheds in Elizabethtown, Kentucky	In Progress
United States Geological Survey (UK College of Agriculture)	Groundwater Basins	Study effects of land-use on water quality of 4 watersheds in Elizabethtown, Kentucky	In Progress
United States Geological Survey	Spring Systems	Monitor water quality and low flow characteristics of 3 public water supply springs, Elizabethtown, Kentucky	In Progress
United States Geological Survey	Vadose zone	Study hydrogeology of the vadose zone and define the fate and transport of agricultural chemicals	In Progress
Warren County Conservation District (319)	Spring systems	Monitor Harris Spring groundwater basin for agricultural practices and storm runoff sedimentation	In Progress

Groundwater Issues

Two issues in Kentucky groundwater must be addressed to effectively manage groundwater resources. The issues, information systems/resource management and increased pesticide usage, are receiving most of the attention of Kentucky agencies at the present.

Information Systems and Resource Management

Kentucky's need for potable groundwater in the future will necessitate management of the groundwater resource. As growth occurs, both in population and industry, more demands are being made on Kentucky's water systems. Recent droughts have prompted interest in groundwater as a more stable, and cleaner, water supply than surface water. Water quality, quantity, and availability must be determined now to intelligently, and safely, use groundwater for large volume users of the future. Information needed for decisions must be in a form that can be readily accessed and integrated with other blocks of information.

In 1990, the Kentucky Legislature mandated that the Kentucky Geological Survey develop a groundwater data repository for data collected by all state agencies (KRS 151:035). Although no funds were allocated, KGS has hired a data base programmer who has begun the development of a relational data base and has developed plans for computer hardware and software to operate the system. The Groundwater Advisory Council is acting as the focal point for discussion of issues related to the creation and operation of the data repository.

The Division of Water has standardized the data acquisition forms for well and spring inspections to ensure data is acquired in the same form throughout the agency. This information will be entered into the database and forwarded to the Kentucky Geological Survey for inclusion in the mandated repository.

These steps toward universality of data information will assist in the technology transfer necessary to make informed decisions. Emphasis must be placed on groundwater resource data acquisition for the information system.

Increased Use of Pesticides In Kentucky

Much of Kentucky's income is from agricultural pursuits. Pesticides and fertilizers used to grow healthy crops may end up in groundwater. Much of the farming occurs in karst areas which may allow surface water access to underground streams before the water can rid itself of the harmful products it carries. The actual extent of pollution from these sources is not known. Studies have been instituted from several aspects to try to understand what happens and how to control and/or reduce pollution from these sources.

Progress in Groundwater Protection Programs

Kentucky has implemented (or is in the process of implementing) several programs that are aimed at protecting groundwater resources within the state. Each addresses a different aspect of pollution potential for the state.

Wellhead Protection Program

The large percentage of the state's population that relies on groundwater resources necessitates that the Commonwealth establish a comprehensive wellhead protection program. Also, in accordance with the 1986 Safe Drinking Water Act Amendments, the Department for Environmental Protection has designated the Groundwater Branch of the Division of Water to be the lead agency for coordinating all wellhead protection efforts for the state. Approximately 31 percent of public and domestic water supplies in Kentucky comes from groundwater sources. There are 211 community, and 311 non-community water suppliers who serve approximately 450,000 persons across the state.

The main goal of Kentucky's Wellhead Protection Program (WHP) is to delineate hydrogeologically sound wellhead protection areas that can be effectively managed by individual communities. Additional program goals are protection, education, and best management practices of groundwater resources in order to ensure a potable drinking water supply in the future. New public water system wells and springs under the WHP should be initially delineated and have a potential source inventory prior to drilling or pumping.

Participation in the WHP applies to all public water systems. The expected completion time for systems to be delineated is 1997. Delineation will be approached in two phases. Each phase is based upon population at risk and aquifer vulnerability.

Groundwater Permitting

The Permit Section of the Groundwater Branch was established on October 16, 1990. The Section was created to develop and administer a regulatory program that implements the groundwater protection goal recommended in the Kentucky Groundwater Protection Strategy. The Permit Section has written and distributed a Groundwater Regulations Issues paper and accepted public comments on the paper. Regulations to classify groundwater and establish groundwater protection standards have been drafted. Groundwater permitting regulations will be drafted in the future.

Water-well Drillers Certification

The program has certified 185 drillers and 190 rig operators to date. Since January 1990, 5,000 well records have been submitted to make a total of 13,000 records on file. Along with monitoring-well drillers certification, which was implemented in July 1991, a requirement for continuing education was added; any driller wishing to renew certification will be required to submit documentation of three hours of education or training.

Monitoring-well Drillers Certification

Regulations requiring the certification of monitoring-well drillers became effective July 1, 1991. Drillers with two or more years of experience were given one year from that date to become "grandfathered" into the program without examination. After July 1, 1992, examination will be required. In addition, monitoring-well construction standards were also adopted effective July 1, 1991. These requirements in Section 13 of 401 KAR 6:310 are:

1) Monitoring wells shall be installed by certified drillers.

2) Monitoring wells shall be constructed in such a manner as to prevent groundwater contamination.

3) Materials used in construction shall be appropriate for the purpose of the well.

4) The annular space above the sampling depth shall be properly sealed.

5) The well shall be completed at least 4 inches above grade or installed with a water-proof flush mount device.

6) A locking cap shall be installed.

7) A record of the well shall be filed with the DOW.

8) If unused, monitoring wells shall be properly abandoned.

This program will improve the quality of monitoring-well construction in Kentucky, help prevent the pollution of groundwater, and will add to the groundwater database. The program has approximately 100 well records received to date, and has certified approximately 60 drillers and rig operators.

A continuing education requirement is also included in the new regulations. Any driller wishing to renew certification will be required to submit documentation of three hours of education or training. Acceptable training includes the Annual Kentucky Water Well Association/Division Of Water Workshop, National Water Well Association classes, in-house training, such as Layne's Well Rehabilitation and Pump Seminar, vendor training and college classes.

Groundwater Education and Well Water Testing Program

A Groundwater Education and Well Water Testing program was instituted in 1990. The Kentucky Division of Conservation, in cooperation with the Kentucky Farm Bureau Federation, the Kentucky Association of Conservation Districts, and the Kentucky Cooperative Extension Service, is implementing the program. The primary goals of this voluntary program are to educate the public on how farming operations and other land activities may cause pollution of surface and groundwater resources, to promote the understanding that pollution prevention through use of best management practices (BMPs) is more cost effective than clean up after damage has occurred, and to increase the knowledge of private well water users. A secondary goal of the program is to provide water well users the opportunity to have their water tested for selected contaminants on a voluntary basis.

The program disseminates information in the form of exhibits, speakers, printed material, and other media at local agricultural groundwater education meetings in most of Kentucky's 120 counties (the program is available to all counties, but a few have declined to participate). The information includes: groundwater concerns; agricultural, forestry, and construction nonpoint source pollution aspects; collection and care of water samples to be analyzed; and a list of laboratories to be used for testing analysis.

The well water testing program cannot be considered a scientific study; however, results from individual well tests can be used to indicate areas in Kentucky that may be particularly susceptible to groundwater and well contamination. Meetings in 82 counties have been conducted to date, with over 4,000 people attending. Water-well samples were collected by residents and submitted for analysis. Of the 4,409 samples tested for nitrates, 4.3 percent contained nitrate levels that exceeded drinking water standards. Analysis of 1,384 samples for atrazine indicated that 0.3 percent exceeded drinking water standards. One percent of the 474 samples tested for alachlor exceeded the drinking water standards.

Groundwater Quality Contamination from Mining and Drilling Activities

For the last ten years, the Kentucky Cooperative Extension Service has conducted training sessions on protecting groundwater contamination by surface mining and oil and gas well operations. Emphasis has been on the processes that lead

to groundwater degradation and how such processes can be predicted and controlled. In 1991, a training manual was compiled from existing information and materials accumulated so that training sessions could be standardized. With one manual, more and better training sessions can occur, thus reaching more people in the state.

Environmental Issues Survey

The Kentucky Environmental Quality Commission (EQC) conducted a survey of county and city officials to determine environmental issues and priorities. EQC's survey provided an opportunity for local officials to identify issues of specific concern to their communities, as well as to rate in order of importance their views on statewide environmental issues. The questionnaire encouraged mayors, county judge/executives, and area development districts to showcase local initiatives with regard to natural resources, recycling, and other environmental issues.

EQC questionnaires were first mailed November 1990, with a follow-up mailing conducted in January 1991. Eleven of fifteen area development districts, 60 of 120 counties, and 87 cities throughout Kentucky responded to the survey.

Groundwater pollution was ranked as the third most significant statewide environmental issue by responding local officials. An estimated one-third of all Kentuckians and 90 percent of the state's rural population rely on groundwater for a source of drinking water. More than 90 percent of the local officials responding expressed an interest in becoming more active in protecting their natural and environmental resources given adequate technical assistance and resources. Seventy-nine percent of all respondents considered pollution of underground sources of water to have high importance.

Underground Storage Tanks

Although the Underground Storage Tank Regulation Program has been in effect since 1984, no information other than the ranking of leakage from tanks has appeared previously in this report. Since the program began, approximately 30,000 tanks have been registered. In the first years of the program, all tanks in service, or taken out of service after 1 January 1974, were required to be registered. Beginning in December 1988, however, older tanks have come under an upgrade schedule for release detection, spill and overfill protection, and corrosion protection requirements. All tanks installed after December 1988 must meet all new requirements in an effort to minimize groundwater contamination. All "old" tanks must meet the standards for new tanks by December 1998.

Assessment of Groundwater Quality

The sources of groundwater pollution are varied and range from waste deposited in landfills, to septic tanks, to industrial sources such as underground storage tanks, and agricultural sources such as land application of fertilizers and pesticides. The major sources of contamination in Kentucky are shown in Table 27. The five highest priority sources have been ranked (one being the most serious). Improper well construction is no longer one of the top five priorities. The introduction of well construction regulations and well driller certification are ensuring that all wells drilled in Kentucky meet safe well construction standards. The major contaminating substances in Kentucky from the sources listed in Table 27 are shown in Table 28. Some pollutants (arsenic, fluorides, and radioactives), though hazardous, affect small or isolated areas and are not presently considered to be major pollutants. By far, the major pollutant in Kentucky is bacteria.

Table 27
Major Sources of Groundwater Contamination

Source	Relative Priority
Septic tanks	2
On-site industrial landfills (excludes pits, lagoons, surface impoundments)	
Other landfills	5
Surface impoundments (excluding oil and gas brine pits)	
Oil and gas brine pits	
Underground storage tanks	1
Injection wells	
Abandoned hazardous waste sites	3
Regulated hazardous waste sites	
Salt water intrusion	
Land application/treatment	
Agricultural activities	4
Road salting	
Improper Well Construction	

Table 28
Substances Contaminating Groundwater

Organic chemicals:	Metals
Volatile	Radioactive material
Synthetic	Pesticides
Inorganic chemicals:	Other agricultural chemicals
Nitrates	Petroleum products
Fluorides	Other (Bacteria)
Arsenic	
Brine/salinity	

Groundwater Indicators

The U.S. EPA in conjunction with a State Task Force has developed a set of indicators to be utilized to track progress and trends in groundwater protection efforts for 305(b) reporting purposes. The indicators are listed below and will be discussed separately.

	Source of Data	Indicator
1.	Public groundwater supplies	• Compliance with MCLs (maximum contaminant levels) and population a risk • Compliance with MCLs by contaminant
2.	Point sources of contamination	• Population at risk from Resource Conservation and Recovery Act (RCRA) Subtitle C and D facilities • Population at risk from the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) sites • Detection of volatile organic compounds (VOCs) in groundwater

3.	Nonpoint sources of contamination	•	Nitrates in groundwater
		•	Leachable pesticide usage

Public Groundwater Supplies

Although many pollutants can be found in Kentucky, only a few currently are known to pollute public water supplies (PWS) in the state (Table 29). There are 522 PWS with a service population of approximately 450,000 that use groundwater in Kentucky. The 22,883 people at risk from MCL violations in 1991 is 5 percent of the total population using groundwater. No PWS were repeat offenders. That is, there were no PWS with violations in both 1990 and 1991. Also, although more violations occurred in 1991, fewer people were at risk from those violations. PWS suffered from bacterial contamination five times more often than from all other contaminants in 1991.

Table 29
Number of Groundwater-Supported Public Water Supplies (PWS) with MCL* Violations

MCL Parameter	Number PWS with MCL Violations 1990	1991
Turbidity	0	3
Barium	1	1
Fluoride	0	0
Nitrate	0	0
Selenium	0	0
Trihalomethanes	0	0
Bacteria	17	19
Population at Risk	34,654	22,883

*MCL = Maximum Contaminant Level

Point Sources of Contamination

RCRA Subtitle C and D Facilities. Contaminants reported from Subtitle C facilities are listed in Table 30. It should be noted that the numbers are considered conservative since they do not include some sites where there is known soil

contamination, nor do they include sites where groundwater contamination is suspected. Many such sites either have no groundwater monitoring or samples have not yet been obtained. The off-site contamination numbers also could be considered conservative, although in some cases "off-site" would represent recharge into a river or stream. There are currently approximately 153 RCRA sites in Kentucky, approximately 45 of which have groundwater monitoring systems.

The information in Table 31 on RCRA Subtitle D facilities represents the findings in a total of 50 permitted solid waste landfill sites in Kentucky. An additional 80 permitted sites have not submitted reports to the Division of Waste Management. These data reflect only wells on-site because, unless specifically requested by a landowner, wells off-site are not monitored by the Division of Waste Management.

CERCLA Sites. Information is available on CERCLA sites in Kentucky for the first time for this report (Table 32). All the sites with off-site contamination also have on-site contamination. Note that some public water supplies have been affected by these sites.

Table 30
RCRA Subtitle C Hazardous Waste Site Groundwater Contaminants (1991)

Contaminant Group[1]	Number of Sites with On-Site Contamination[2]	Number of Sites with Of Site Contamination[3]
Metals	21	4
Volatile Organics	28	6
Semi-volatile Organics	4	1
PCBs	1	1
Pesticides	2	0

[1]Most sites are impacted by more than one contaminant group.
[2]Total Number of sites with on-site contamination = 28.
[3]Total Number of sites with off-site contamination = 10.

Table 31
RCRA Subtitle D Solid Waste Site Groundwater Contamination (1991)

Contaminant Group	Number of Sites, 1990	Number of Sites, 1991
Metals	12	16
Organics	13	17
Pesticides	Those landfills that ran this analysis did not show contamination above MCLs	
PCBs	No PCBs from these sites have been reported in Kentucky	

Table 32
CERCLA Site Groundwater Contamination

Sites With Contamination:	1990	1991
On-Site	63	72
Off-Site	13	14
Affecting Public Water Supplies	3	1

Detection of VOCs in Groundwater. Volatile Organic Compounds (VOCs) were detected in 19 PWS in 1990 and in 16 PWS in 1991 (Table 33). Five PWS had detections in both 1990 and 1991. Also, five PWS had VOCs above MCLs in 1991. Two PWS were closed due to VOC contamination in 1990. Both, however, are working on remediation of their problem.

Table 33
Groundwater Supported Public Water Supplies (PWS)
with Volatile Organic Chemical Contamination

Volatile Organic Compound	Number of PWS with VOC Detections	
	1990	1991
1,1,1-trichloroethane	7	3
trichloroethylene	4	2
benzene	3	1
carbon tetrachloride	1	2
vinyl chloride	1	
dichloromethane	1	
1,4-dichlorobenzene	4	
1,2-dichloroethane	1	
p-dichlorobenzene		3
Population at Risk	39,439	19,545

Nonpoint Sources of Contamination

Nitrates. Nitrate contamination information was not available for this report.

Pesticides. Pesticide information was gathered by the Department of Agriculture, Division of Pesticides and is presented in Table 34. The data used are the amount of pesticides sold in a county per year. Eighty-six counties reported data, 34 did not. Data for previous years were not available.

Table 34
Pesticides in Kentucky
(1991)

Pesticide Use Intensity (lbs/sq. mile)	Number of Counties (1991)
0-400	76
401-1,000	9
1,001-1,430	1

CHAPTER 4

WATER POLLUTION CONTROL PROGRAMS

POINT SOURCE CONTROL PROGRAM

Wastewater Treatment Facility Permitting

Point source pollution refers to any discharge from municipal or industrial facilities that can be identified as emanating from a discrete source such as a conduit or ditch. Kentucky has a total of 3,023 active permits covered by the Kentucky Pollutant Discharge Elimination System (KPDES) program. Over 4,000 additional coal mining-related discharges are covered under the KPDES Coal General Permit. New federal mandates require expansion of the point source program to include stormwater runoff and combined sewer overflows. Kentucky has been issuing stormwater permits for more than five years to major industrial discharges with process wastewater (such as power plants, refineries, and chemical plants) and others with a significant potential for water quality problems from their runoff (petroleum bulk plants and concrete mix plants). A permitting strategy is being developed to cover industries that have not been previously permitted that are subject to the new regulations.

The overflow from combined sanitary and stormwater sewers in excess of the interceptor sewer or regulatory capacity, that is discharged into a receiving water without going to a publicly owned treatment works (POTW), is considered a combined sewer overflow (CSO). The number of CSO points statewide currently consists of 231 from a total of 21 separate systems. Most of these are located on larger streams such as the Ohio River and Kentucky River. The state began to include permit language addressing CSOs in the summer of 1991 as permits expired and were reissued. Currently, three permittees have permits reissued with CSO language included, and these three permits cover 168 of the identified CSO points.

In conjunction with a Northern Kentucky permitted facility, which had the largest number of CSO points for a single permittee, a Section 104(b)(3) grant has been awarded to the Division. Water quality data specifically related to CSO events will be collected to determine the role of CSOs on the water quality problems in the study area. This information will be valuable in developing a statewide database for tracking CSO trends and should facilitate future permitting and implementation strategies.

Wastewater permit limits in Kentucky have been water quality-based since National Pollutant Discharge Elimination System (NPDES) program delegation on September 30, 1983. Generally, there are two approaches for establishing water quality-based limits for toxic pollutants: chemical-specific limits, which are individual chemical criteria for determining discharge limits for all known toxic or suspected toxic pollutants in an effluent; or whole effluent toxicity testing, which sets limits on an effluent's total toxicity as measured by acute and/or chronic bioassays on appropriate aquatic organisms.

Both approaches have advantages and drawbacks, but when both are integrated into a toxics control strategy, they provide a flexible and effective control for the discharge of toxic pollutants.

Toxicity data are available for only a limited number of compounds. Single parameter protection criteria, therefore, often do not provide adequate protection of aquatic life if the toxicity of the components in the effluent is unknown, there are synergistic (greater than predicted) or antagonistic (less than predicted) effects between toxic substances in complex effluents, and/or a complete chemical characterization of the effluent has not been carried out. Since it is not economically feasible to determine the toxicity of each of the thousands of potentially toxic substances in complex effluents or to conduct exhaustive chemical analyses of effluents, the most direct and cost-effective approach to measuring the toxicity of effluents is to conduct effluent toxicity tests with aquatic organisms.

Effluent Toxicity Testing

In 1988 the Commonwealth of Kentucky adopted an integrated strategy to control toxic discharges into surface waters. This toxics control strategy was implemented by including both chemical-specific limits and whole effluent toxicity (WET) limits in KPDES permits issued to industrial and publicly-owned treatment works (POTWs). These limits were applied to most major and selected minor industrial dischargers, major municipal dischargers, and minor municipal dischargers with an approved pretreatment program. The WET limitations were developed for both acute and chronic levels based on a case-by-case evaluation of the discharge type and volume, and the size of the receiving stream. To date, the Division of Water has issued 112 permits with WET limitations. Of the 112 permits, 35 are industrial and 77 are municipal.

During 1990 and 1991, WET tests were conducted on point source dischargers throughout the state. The Division of Water tested 68 facilities. A total of 1,212 tests were conducted by 112 facilities in compliance with KPDES biomonitoring permit requirements. All the Division of Water tests were 96-hour static-renewal bioassays using Ceriodaphnia dubia and Pimephales promelas as the test organisms. Results of the Division of Water's toxicity tests are summarized in Table 35.

Biomonitoring test results are submitted with a facility's discharge monitoring reports (DMRs) on a monthly basis for the first year of biomonitoring, after which tests are performed quarterly. Test species are Ceriodaphnia dubia and Pimephales promelas. Acute tests are 48-hour static exposures and chronic tests are the 7-day P. promelas growth test and 7-day C. dubia reproduction test. Two consecutive failures of a single concentration "screen" test, using the permitted concentration, results in a facility's entering a toxicity reduction evaluation (TRE). Screen test failures are summarized in Table 36.

Approximately one-third of all facilities currently with biomonitoring permit limits are conducting TREs. A summary of facilities in TRE status by the end of 1991 is shown in Table 37.

Table 35
Division of Water Effluent Toxicity Testing
1990-1991

Facility Type	Prechlorinated Effluent			Final Effluent		
	Number Toxic	Total Tests	Percent Toxic	Number Toxic	Total Tests	Percent Toxic
			1990 Results			
Municipal						
Major	8	11	73	7	15	47
Minor with pretreatment	1	1	100	1	6	17
Minor	7	9	78	11	11	100
Total Municipal	16	21	76	19	32	59
Industrial	0	0	NA	0	1	0
			1991 Results			
Municipal						
Major	2	2	100	2	7	29
Minor with pretreatment	0	0	NA	1	2	50
Minor	1	1	100	7	14	50
Total Municipal	3	3	100	10	23	43
Industrial	0	0	NA	4	9	44

Table 36
KPDES Permittee Effluent Toxicity Testing
1990-1991

Facility Type	Total Screening Tests	Number Failed	Percent Failure
	1990 Results		
Municipal			
Major	292	121	41
Minor	50	22	44
Total	342	143	42
Industrial			
Major	138	27	20
Minor	34	14	41
Total	172	41	24
	1991 Results		
Municipal			
Major	403	209	52
Minor	101	31	31
Total	504	240	48
Industrial			
Major	124	50	40
Minor	70	34	49
Total	194	84	43
Total Both Years	1,212	508	42

Table 37
Summary of Toxicity Reduction Evaluations (TREs)
1991

Facility Type	Number with Biomonitoring	Number in TREs	Percent TREs
Municipal			
Major	59	24	41
Minor	18	4	22
Total	77	28	36
Industrial			
Major	26	6	23
Minor	9	5	56
Total	35	11	31
Grand Total	112	39	35

By the end of 1991, three facilities had completed their TREs and another 13 could be finished by the end of 1992. The reduction of toxic discharges is being achieved as summarized below (by number of facilities):

Methods	Number
New treatment plant construction	4
Plant improvements	5
Plant operation changes	5
Treatment options identified	6
Toxic sources identified	2

Toxicity identification evaluations (TIEs) have been performed on a number of facilities with varying success. The most commonly found groups of toxicants are metals and pesticides. The following is a list of the number of facilities identifying different groups of toxicants in their effluent. Most of those identified have yet to be confirmed as the cause of toxicity because of the variability in municipal wastewater composition.

Toxicants	Number
Metals	7
Pesticides	4
Surfactants	2
Polymers	2
Ammonia	2
Others	4

A closer examination of the facilities in TREs has revealed that treatment type can play a significant role in the degree of toxic discharge. Facilities with rotating biological contactors (RBCs) have the greatest frequency of entering a TRE. Seventy-nine percent (11 of 14) of all facilities with biomonitoring permit limits and RBCs were in a TRE, compared with an overall rate of 35 percent. This high rate of TREs among RBC facilities accounts for nearly half of all major municipal facilities that are in TRE status. Another observation is that older RBC facilities have a greater frequency of entering a TRE, which is an apparent reflection of RBC's poor performance record. More research is needed in the area of treatment plant design to reduce toxic discharges. The facility design review and funding process has been changed to prevent further construction of RBC facilities. EPA needs to develop a mechanism to accelerate their replacement.

Pretreatment Program

The quality of Kentucky's surface waters continues to face a threat from improperly treated industrial waste discharged into municipal sewage treatment systems. Such waste often contains pollutants that are either not removed by the municipal treatment process or, if removed, result in the generation of contaminated sludge. In an effort to control this problem, Kentucky has approved pretreatment programs in 69 cities and has screened several others to determine their need for a pretreatment program. A list of communities with approved pretreatment programs and the estimated costs to administer the local program is presented in Table 38. The facilities needing programs are all on schedule for obtaining approval. Once approved, each program is inspected annually and must submit semi-annual status reports to the Division of Water for review. These reports are incorporated into the computer files known as the Permit Compliance System (PCS) and Pretreatment Permits and Enforcement Tracking System (PPETS).

The National Pretreatment Excellence Awards recognize those publicly owned wastewater treatment plants that have developed and implemented effective and innovative pretreatment programs. EPA's award program is divided into four categories based on flow of the POTW: 0 to 2.0 MGD, 2.01 to 5.0 MGD, 5.01 to 20.0 MGD, and greater than 20 MGD.

Table 38
Total Estimated Level of Annual Funding Required to Implement the POTW Pretreatment Program

No.	POTW	$/Year
1	Adairville	$15,000
2	Ashland	85,163
3	Auburn	108,000
4	Bardstown	25,000
5	Beaver Dam	5,000
6	Berea	7,000
7	Bowling Green	52,200
8	Cadiz	12,000
9	Calhoun	In-Active
10	Calvert City	2,500
11	Campbellsville	46,410
12	Campbell/Kenton SD#1	132,000
13	Caveland Sanitation	14,880
14	Corbin	68,046
15	Cynthiana	12,000
16	Danville	13,000
17	Edmonton	2,000
18	Elizabethtown	350,000
19	Elkton	1,000
20	Eminence	22,500
21	Flemingsburg	9,000
22	Frankfort	85,000
23	Franklin	40,550
24	Fulton	18,000
25	Georgetown	12,000
26	Glasgow	22,600
27	Guthrie	7,000
28	Harrodsburg	13,000
29	Hartford	6,260
30	Henderson	60,300

Table 38 (Continued)

No.	POTW	$/Year
31	Hopkinsville	151,000
32	Jamestown	23,000
33	Lancaster	1,000
34	Lawrenceburg	22,500
35	Lebanon	10,000
36	Leitchfield	35,895
37	Lexington	331,200
38	Livermore	5,506
39	London	15,000
40	Louisville	1,397,900
41	Madisonville	32,000
42	Marion	13,500
43	Mayfield	12,500
44	Maysville	9,000
45	Middlesboro	12,000
46	Monticello	8,000
47	Morganfield	In-Active
48	Morgantown	25,929
49	Mt. Sterling	13,500
50	Murray	20,000
51	Nicholasville	47,000
52	Owensboro	61,000
53	Owningsville	1,000
54	Paducah	78,000
55	Paris	20,000
56	Princeton	13,500
57	Richmond	16,562
58	Russellville	21,500
59	Scottsville	1,400
60	Shelbyville	19,180
61	Somerset	60,000
62	Springfield	6,000
63	Stanford	2,000
64	Tompkinsville	5,000
65	Versailles	1,000
66	Williamsburg	9,000
67	Williamstown	4,350
68	Winchester	64,000
69	Wurtland	7,000
	Total	$3,824,331

In the three years that local programs have been recognized, Kentucky POTWs have faired well each year, with a total of five programs receiving the awards:

Year	POTW	Category
1989	Louisville MSD	(20 + MGD)
1990	Bardstown	(0 - 2.0 MGD)
	Richmond	(2.01 - 5.0 MGD)
1991	Leitchfield	(0 - 2.0 MGD)
	Corbin	(2.01 - 5.0 MGD)

Municipal Facilities

Construction grants, state revolving loan fund monies, and other funding programs have resulted in the construction of over $116 million in wastewater projects which came on line during 1990-1991 as indicated in Table 39. Thirty municipal wastewater projects were completed during this two year period. An additional 20 to 25 projects are in various stages of construction.

Although significant improvements in water quality have been realized through the construction of new wastewater treatment facilities, there are numerous needs that remain to be addressed. The 1990 Needs Survey, conducted by the Division of Water as part of its planning process, indicated that municipal discharges continue to impair water quality and pose potential human health problems. State and federal minimum treatment requirements are not being met in every instance. The 1990 Needs Survey identified a capital investment need of $1.133 billion to construct and rehabilitate wastewater treatment facilities and components for Kentucky, based on the 1990 population. Backlog needs of $1.133 billion, coupled with long-range needs for publicly-owned treatment facilities, reveal a projected total need of over $1.485 billion through the year 2010. A detailed breakdown of investment needs is presented in Table 40.

The 1986 305(b) Report to Congress described Kentucky's Water Infrastructure Report and concluded that a revolving loan fund concept was the most feasible option for Kentucky in meeting its water infrastructure needs. Because the federal law was not in place at that time, Kentucky was unable to pass appropriate legislation during the 1986 Kentucky General Assembly.

When the 100th Congress of the United States passed HR 1, the final step toward elimination of grants and establishment of state revolving funds was initiated. States were given the option of using a portion of the allotment for grants through FY 90.

Table 39
Wastewater Treatment Facilities That Came on Line
During Calendar Years 1990-1991

Type of Funding/City	Date on Line	Design Flow (mgd)	Treatment Cost	Interceptors
Grant				
Beaver Dam	8/90	0.711	$1,460,000	$25,000
Berea*	5/91	2.100	231,000	0
Cave City	5/91	0.600	2,320,348	1,334,998
Central City	9/90	0.973	2,858,940	883,970
Elkton*	5/91	0.272	303,675	0
Horse Cave	5/91	0.280	2,320,348	1,334,998
Inex	9/90	0.260	1,447,769	4,044,888
Irvington	11/90	0.144	818,000	1,778,728
Lexington - Town Branch	11/90	30.000	48,807,025	0
Louisville - West Co.	5/90	15.000	19,759,312	8,543,754
Manchester	11/90	0.581	1,505,566	615,243
Middlesboro	7/91	-	0	606,915
Millersburg	3/91	0.200	582,644	0
Oak Grove	12/91	0.500	-	372,459
Sacramento	9/90	0.062	465,786	1,218,553
Shelby Co. Sanitation Dist.	9/90	-	0	2,163,282
Whitesburg	1/91	0.500	768,525	0
Total			$83,648,938	$22,922,788
Loan				
Jackson	8/91	0.750	$3,241,350	
Jenkins	5/91	0.750	2,624,166	
Manchester	11/90	0.581	1,938,084	264,284
Mt. Washington	3/91	0.900	1,217,000	
Perryville	2/91	0.100	715,871	
Total			$9,736,471	$264,284
Auburn	8/90	0.350		
Brodhead	7/91	0.150		
Henderson	8/91	7.500		
McKee	3/90	0.170		
Oak Grove	12/91	0.500		
Wurtland	7/91	1.100		
Versailles	8/91	3.000		
Totals for EPA Funded Projects			$93,385,409	$23,187,072

*Modification or Replacement

Table 40
Investment Needs for Wastewater Treatment Facilities in Kentucky 1990-2010
(In millions of January 1990 dollars)

Facility	For Current 1990 Population	Projected Needs 2010 Population
Secondary treatment	$134	$181
Advanced secondary treatment	47	57
Infiltration/Inflow	81	81
Major rehabilitation of sewers	12	12
New collector sewers	562	693
New interceptor sewers	273	437
Correction of combined sewer overflows	24	24
Total	$1,133	$1,485

Kentucky made the decision to place all federal dollars in the revolving fund to the extent possible beginning in FY 88. A few large segmented grant projects required continuation of some grant funding through FY 90. An early transition from grants to loans assured more available dollars in the revolving loan fund over the long term.

Kentucky state legislation was passed March 14, 1988. Kentucky has received four capitalization grants from EPA. These grants of FY 88 through FY 91 federal funds total $88.2 million. Provisions have been made in the state biennial budget for the 20 percent match, and it is estimated that approximately $156 million will be available in federal and state funding through 1994 when federal funding is to cease. This should be a first step toward funding the $431 million of requests contained in the state's priority list, as well as other wastewater needs that have not yet been placed on the priority list.

The funding formula, which distributes capitalization grant money to the states, currently provides Kentucky with only 1.2872 percent of the amount authorized nationally for each fiscal year. In comparison with total national wastewater facility needs, this figure falls short of the 1.64 percent that exists in Kentucky. Also, if compared with population based on 1990 census figures, the allotment percentage falls short of the 1.47 percent of population in Kentucky. A funding allotment percentage for Kentucky of approximately 1.55 percent would be more in line with needs and population figures. The estimated annual difference in available state revolving fund money would translate into two or three additional wastewater projects for Kentucky communities.

The law originally provided an authorization of appropriations beginning at $2.4 billion and tapering to $.6 billion for fiscal year 1994. To date, actual appropriations have fallen short of the authorized figures. Consideration should be given to maintaining a higher funding level and extending the funding beyond 1994 at least to the point of allotting the total amount originally planned. This higher level of funding and extension beyond 1994 are necessary to assure that states establish a financially healthy, perpetual revolving fund.

Wastewater Regionalization

Over the last two years, the Division of Water has used funds from Section 205(j) of the Clean Water Act to assist it and regional planning organizations to develop regionalization approaches to treat wastewater. The objective of this initiative is to discourage the proliferation of small privately-owned package treatment plants in the state. Contracts with four area development districts, one regional health organization, and the Council of State Governments have provided information for the development of regionalization strategies at the state and local level and have provided technical assistance at the plants to enhance water quality.

Some of the results of this initiative have been the elimination of a number of existing package treatment plants, prevention of package treatment plant construction by connection to municipal systems, inclusion of siting restrictions on package treatment plants in local master plans, and planning and zoning ordinances. The improvement in operations at some package plants has also occurred because of the takeover by a responsible public entity.